Watershed Model

Objectives

Students will understand that water flows through a path that connects watersheds, and wherever you are, you are in a watershed. Students will: investigate drainage patterns, observe how watersheds distinguish different land areas, and discover the origin of the water used in their local community.

Curricular Areas

Science skills (observing, predicting, hypothesizing, analyzing), Language Arts, Social Studies

California Content Standards

GRADES 4-8

Science

4th Earth 5 a, b, c; Investigations 6 a, c, d
5th Earth 3 a, b, c, d, e; 4 a, b, c; Investigations 6 a, b, c, g, h
6th Earth 1 f, 2 a, b; Investigations 7 a, b, d, e, f, g, h
7th Earth Life 4 a, c; Investigations 7 a, c, d, e

Social Studies

4th 4.1, 4.4

English Language Arts

4th Speaking 1.0, 2.0
5th Speaking 1.0, 2.0
6th Speaking 1.0, 2.0
7th Speaking 1.0, 2.0

Method

Where does your water come from? Students will build a model watershed and predict where the water will travel across the land.

Materials

- Time to complete: (2) 50-minute class periods. For permanent watershed model, allow at least three days for materials to dry before conducting experiments.
- Transparencies of "Branching Patterns" and "Watershed in Your Hands"
- Blue food color
- Spray bottles, one for each model
- Drawing paper and pencil
- Blue pencils, blue and brown washable markers (one set for each group)
- Tracing paper or blank transparency sheets
- Photocopies of a local map showing rivers ("California Waterways" illustration), one for each student
- Overhead projector

For Model:

NOTE: Allow extra time to make this model. Begin it at least three days before the experiments are to be conducted-the papier-mâché needs to dry overnight, and then the paint needs time to dry completely.

- Five to ten rocks, ranging from 2 to 6 inches (5 to 15 cm) in height.
- If groups of students are making their own models, each group will need its own rocks.
- Square or rectangular aluminum tray, large enough to hold rocks. A large disposable baking or turkey roasting pan will work.
- Plastic wrap (thick plastic wrap from a grocery or butcher shop works best).
- Papier-mâché materials (strips of newspaper dipped in a thick mixture of flour and water)
- Water-resistant sealer and white paint

Background

Wherever you are, you are in a *watershed,* which is the land area from which surface runoff drains into a stream channel, lake, ocean, or other body of water. A watershed is a system. It is the land area from which water, sediment, and dissolved materials drain to a common watercourse or body of water. For each watershed there is a drainage system that conveys rainfall to its outlet. The boundaries of a watershed are determined by the guiding contours of the land surrounding the stream, river, lake or bay.

A watershed is more than just a geological feature. It is a hydrologic system linking all living things within its boundaries. Not only is all plant and animal life dependent upon the water within each watershed, but the watercourses are also conduits that transport water, organisms, nutrients and other materials within the system. What affects one watershed eventually affects

other sites downstream.

When the ground is saturated or impermeable to water (when water cannot soak into the ground) during heavy rains or snowmelt, excess water flows over the surface of land as runoff. Eventually this water collects in channels such as streams. The major stream and river that drains a land area provides the name for the watershed. In Sacramento we live in the Sacramento River watershed, the largest watershed in California; it includes the American River watershed, as well as many others. The smaller watersheds drain into the Sacramento River, which carries water from the entire watershed toward the Pacific Ocean.

Ridgelines, or divides, separate watersheds from each other by areas of higher elevations. Near the divide of a watershed, water channels are narrow and can contain fast-moving water. At lower elevations, the slope of the land decreases, causing water to flow more slowly. Eventually, water collects in a wide river that empties into a body of water, such as a lake or ocean.

By investigating drainage patterns, we can better understand how watersheds distinguish different land areas. The pattern water makes as it flows through a watershed is familiar to students who have drawn pictures of trees or studied the nervous system.

From a bird's eye view, drainage patterns in a watershed resemble a network similar to the branching pattern of a tree. Tributaries, similar to twigs and small branches, flow into streams, the main branches of the tree. Like other branching patterns (e.g., road maps, veins in a leaf), the drainage pattern consists of smaller channels merging into larger ones.

Watersheds are either closed or open systems. In closed systems, such as Mono Lake in northeast California, water collects at a low point that lacks an outlet. The only way water is removed is by evaporation or seeping into the ground. Most watersheds are open. That means water collects in smaller drainage basins that overflow into outlet rivers and eventually empty into the sea.

Procedure

Before class:

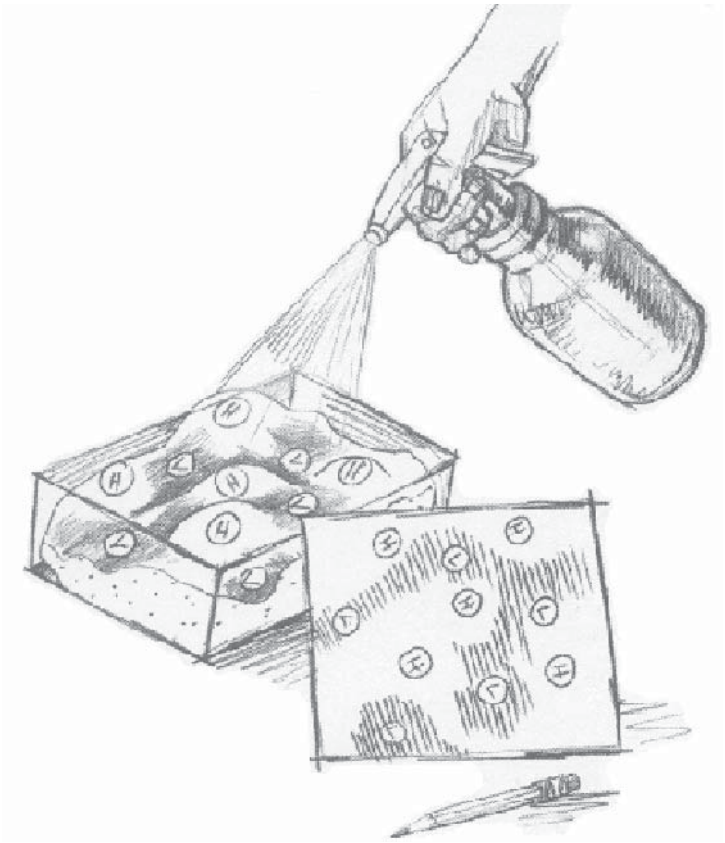
1. Purchase or have students bring in appropriate materials (see list)
2. Photocopy map of the area with rivers and streams. One copy for each student.
3. Photocopy onto overhead transparency "Branching Patterns" sheet.

During class:

1. Ask students what they know about watersheds. Do they live in a watershed? (Trick question: wherever you live, you are in a watershed, even in the middle of a city. The water falls on the asphalt and runs-off into a drainage system.) Assist the students in defining a watershed. Tell them they will build a model that will help them understand how the water flows through the drainage system.
2. The first model will be a very temporary one. It will provide students with a basic understanding and aid in the development of the more permanent model.
3. Group students into small groups of 3-4 students.
   a. Cover table with plastic tablecloth
   b. Provide each group with a brown and blue washable marker and a sheet of paper
   c. Instruct students to crumple the sheet of paper. Place the paper on the table and open so that there are high and low areas. With the markers draw lines on the ridges of the paper (the high areas). Use both colors together.
   d. Now it is going to rain. With the spray bottle, spray water above the paper.
   e. The colored ink will run along the creases of the paper from the highest to the lowest points.
   f. This is how a watershed works. What do the colors represent? Why would the brown color be used?
   g. Have students think about the word "shed." It can mean something that stores things, like a garden shed, or it can mean to let something run off, like an umbrella that sheds water. A watershed does both! Some rain that falls on the watershed runs

off, carving the land into hills and valleys in a slow process called "erosion." As water flows it causes erosion, and small particles of mud, sand, and rock are transported downstream.

4. Show overhead transparency, "Branching Patterns." Is this like the crumpled paper model?
5. Tell students that each small group will make a permanent watershed model and conduct experiments with their model. If possible, make a sample model to show students. Distribute materials to each group.
   a. Instruct students to lay rocks in a square or aluminum tray, with larger rocks near one end.
   b. Snugly cover the rocks and exposed areas of the tray with plastic wrap. Apply strips of papier-mâché to cover the rocks. For a sturdier model, apply several layers of papier-mâché.
   c. When the mâché has dried, coat the model with white paint and waterproof sealant, or waterproof white paint.
6. Once the model is complete, have students sketch a bird's eye view of the model. They should mark points of higher elevations with "H" and low spots with "L" to identify possible ridgelines; connect the "H"s.
7. It is now time for a rainstorm. Where will the water flow and collect in the model? Have them sketch their prediction on their drawings. Indicate the crevices in their models and possible locations of watersheds.
8. Students will spray blue-colored water (food coloring in water) over the model and note where it flows. Water may need to be sprayed for several minutes to cause a continual flow. Assist students in identifying branching patterns as water from smaller channels merges into larger streams.
9. Have students use blue pencil to mark on their drawings the actual branching patterns of water. Some imagination and logic may be required. Ask them to confirm the locations of watersheds by checking where water has collected in the model.
10. Ask students to determine if smaller



watersheds overflow into larger ones. Does all the water in the model eventually drain into one collection site (open watershed system)? Does the model contain several closed water systems (collection sites that lack an outlet)?

11. Have students place tracing paper or an overhead transparency over their drawings and draw the drainage patterns. Groups compare and contrast each other's drawings. Discuss how the networks of smaller channels merge together to become larger.
12. Hand out photocopied maps of local areas with streams, rivers, and lakes. Students locate streams and rivers and draw a circle around land areas they think drain into the river.
13. Students pick one river on the map and follow its path in two directions (upstream and downstream). If the entire river is pictured, one direction should lead to the headwaters or source, and the other direction should merge with another river or empty into a body of water.
14. As a review, use the transparency "Watershed in Your Hands." Have students create a model of the Sacramento River watershed with their hands and identify the features of the watershed.

Extensions

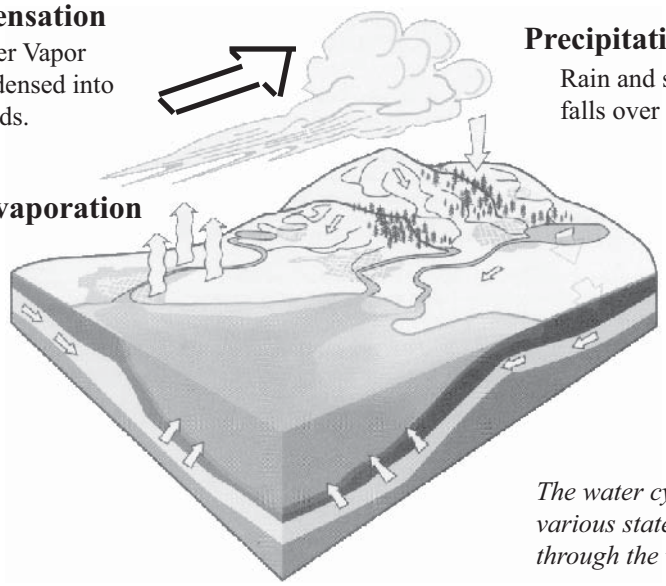
1. If the model was a real land area, would the drainage patterns be the same thousands of years from now? Students should consider

the affects of natural and human-introduced elements (e.g., landslides, floods, erosion, evaporation, water consumption by plants and animals, runoff from agricultural fields, droughts, and dams). Have students write one page describing what the future watershed looks like.

2. Students may finish their models by painting landscapes and constructing scale models of trees, wetlands, and riparian areas. Introduce human influences, such as towns and roads.
3. Students may make a topographic map of their model. First, they totally waterproof the model.

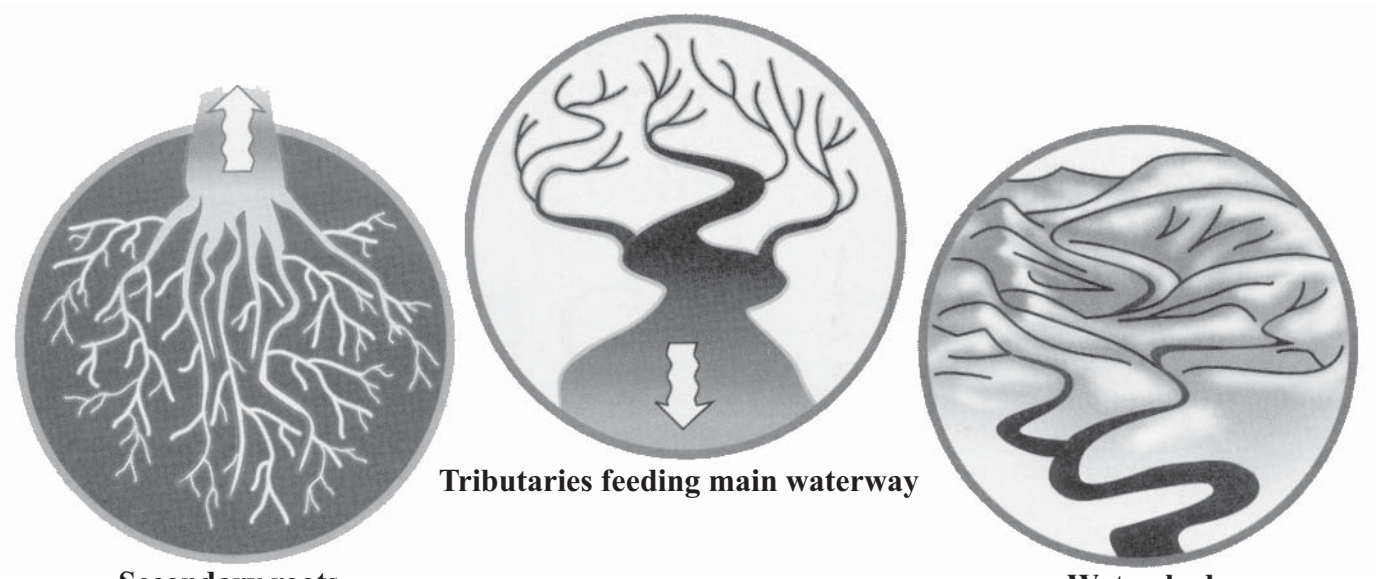
Activity adapted with permission from *Waves, Wetlands and Watersheds*, published by the California Coastal Commission (www.coastforyou.gov) and *Project WET Curriculum and Activity Guide*. For more information about Project WET (Water Education for Teachers), contact the national office at (406) 994-5392, or the California Project WET Water Education Foundation (916) 444-6240, www.watereducation.org.

The Water Cycle



The water cycle is the path water takes through its various states–vapor, liquid, and solid–as it moves through the watershed.

Branching Patterns



Secondary roots feeding primary tree

Tributaries feeding main waterway

Watershed

Watershed In Your Hands